67. *Tertiary Foraminiferous Rocks of the Philippines.*[1]

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(Comm. by H. YABE, M.I.A., May 12, 1928.)

Lately we have examined a great number of Tertiary foraminiferous rocks of the Philippines, sent by Dr. R. E. Dickerson and Dr. J. Cushman for microscopic study. The collection is from the Philippine Bureau of Science and comprises samples collected by Dr. Dickerson and his colleagues in many years labour; it is perhaps the most comprehensive collection of foraminiferous rocks of the islands ever studied and is specially valuable to us, as it contains many specimens derived from the original localities of the forms early described by Prof. Dr. H. Douvillé[2] of Paris and Dr. W. D. Smith[3] of Eugen. We are under deep obligation to Dr. Dickerson, Dr. Cushman and the Philippine Bureau of Science for the kind offer of this rich material to our study.

The present material comprises some 80 samples; with few exceptions these are found to contain foraminifera. While 62 contain more or less foraminifera of large sizes, 9 are *Globigerina* rocks poor in larger forms. The geographical derivation of these foraminiferous rocks are:

	Number of samples with large foraminifera	Number of *Globigerina* rocks
Island of Cebu	26	3
Island of Mindanao	3	1
Island of Palawan	1	—
Island of Mindoro	4	—
Island of Samar	5	1
Island of Masbate	1	—
Island of Batan	5	—
Island of Luzon	17	2
Island of Leyte	—	2

These foraminiferous rocks are certainly derived from several different geological horizons and very varied in their constituent

1) Our previous publications on the same subject are:— H. Yabe: Notes on a *Lepidocyclina*-Limestone from Cebu. Sci. Rep. Tohoku Imp. Univ. 2nd ser. (Geol.), Vol. V, No. 2, 1919.
H. Yabe and S. Hanzawa: Note on Some Tertiary Foraminiferous Rocks from the Philippines. Ibid, Vol. VII, No. 4, 1925.

2) H. Douvillé: Les Foraminifères dans le Tertiaire des Philippines. Phil. Jour. Sci., Vol. VI, No. 2, 1911.

3) W. D. Smith: *Orbitoides* from the Binangoan Limestone. Ibid. Vol. I, No. 2, 1906.

foraminifera. Among them, there is but one, which is distinguished from all the others by containing *Nummulites* and *Orthophragmina* ("Palawan, 2127"); it is evidently not younger than the Older Oligocene, and this is perhaps the first record of the occurrence of such an old Tertiary sediments in the Philippines, based on a palaeontological evidence.

Prof. H. Douvillé once reported a nummulitic rock, with *Nummulites subniassi* Douvillé, from the island of Batan; this was regarded by him to be Stampian in age, and to be the oldest foraminiferal horizon of the Philippine Tertiary, then known. In our material, there is one sample derived from the same island ("Batan, 5"); its foraminifera are, however, believed by us to be *Operculinella venosa* F. et M. rather than *Nummulities subniassi*. These two foraminifera can easily be distinguished in a transverse section, but appear quite similar in features exposed in sagittal section; moreover, they are nearly similar in size. Consequently we are rather in doubt, whether his material from Batan is really different from ours. A somewhat smaller form, otherwise almost indistinguishable from *Operculinella venosa*, is common in several samples from Luzon ("1060," "1061," "1063"); unfortunately all other foraminifera found in association in these rocks belong to rather indifferent types. It is worthy of note that we have recently obtained a similar rock with the same foraminifer from the southern part of Formosa. *Operculinella venosa* also occurs alone in a sample from Mindanao (462) and in association of *Lepidocyclina angulosa* Provale, *Miogypsina irregularis orientalis* Douvillé, *Cycloclypeus communis* Martin and *Amphistegina lessonii* d'Orb. in a *Lepidocyclina* limestone from Cebu (804); the last rock may be Burdigalian in age.

The great many samples are characterised by having *Eulepidina*; we have now 14 samples with *Eulepidina* from Cebu, 3 from Mindanao 1 from Samar, 1 from Masbate, 3 from Luzon; most of them accompany either *Nephrolepidina* and *Cycloclypeus* (or/and *Spiroclypeus*) or *Cycloclypeus* (or/and *Spiroclypeus*) alone. Some *Eulepidina* rocks ("Cebu, 30—31 x"; "Cebu, 1823"; "Cebu, 12," "Luzon, 1") possess a dwarf form of *Alveolina* s. s. and *Heteroclypeus*?. On the other hand, "Cebu, 61 x" has *Gypsina*, and *Amphistegina*, beside these two peculiar forms; this specimen may perhaps be equivalent to the preceding ones with *Eulepidina*.

Likewise there are many specimens which contain *Nephrolepidina* and lack *Eulepidina*; 3 specimens from Cebu, 1 from Mindoro, 2 from Samar, 4 from Batan and 6 from Luzon belong to this category; most of these rocks possess either *Miogypsina* and *Cycloclypeus* or

species belonging to one of the two genera. There is a sample with *Cycloclypeus communis* and *C. annulatus*, but not any species of *Lepidocyclina* ("Luzon, F. 277"); this may possibly be equivalent to the *Eulepidina* rocks rather than to the *Nephrolepidina* rocks.

The specimens, "Luzon, 24" and "Mindano, 617," have *Miogypsina*, but there is neither *Lepidocyclina* nor *Cycloclypeus* in them; these may be younger than, or at most as old as, the *Nephrolepidina* rocks.

The remaining specimens are free from *Lepidocyclina*, *Miogypsina*, *Spiroclypeus* and *Cycloclypeus*. They are partly hemipelagic marl, full of minute shells of pelagic foraminifera, and their geological age can only be settled stratigraphically; the other part are believed by us to have been derived from the raised limestone formation of the youngest Tertiary or later date.

The large foraminifera discriminated in these rocks are:

Orthophragmina (*Discocyclina*) *javana* Verbeek
O. sp.
Lepidocyclina (*Eulepidina*) *richthofeni* Smith
L. (*E.*) *richthofeni plana* Yabe and Hanzawa
L. (*E.*) *formosa* Schlumb.
L. (*E.*) *gibbosa* Yabe
L. (*E.*) *monstrosa* Yabe
L. (*E.*) aff. *chapmani* Nuttall
L. (*E.*) *dickersoni* Yabe and Hanzawa
L. (*E.*) *inermis* Douvillé
L. (*E.*) *cebuensis* Yabe and Hanzawa
L. (*Nephrolepidina*) *angulosa* Provale
L. (*N.*) *brouweri* Rutten
L. (*N.*) *sumatrensis* Brady
L. (*N.*) *sumatrensis minor* Rutten
L. (*N.*) *ferreroi* Provale
L. (*N.*) *verbeeki* Newton and Holland
L. (*N.*) *inflata* Provale
L. (*N.*) aff. *flexuosa* Rutten
L. (*N.*) *douvillei* Yabe and Hanzawa
L. (*N.*) cfz. *douvillei* Yabe and Hanzawa
L. (*Trybliolepidina*) *rutteni* Van der Vlerk
L. (*Pliolepidina*) *luxurians* Tobler
Lepidocyclina sp.
Heteroclypeus cycloclypeus Silvestri ?
Cyclocypeus communis Martin
C. *annulatus* Martin
C. *martini* Van der Vlerk ?
Heterostegina depressa d'Orbigny
Operculina bartschi ornata Cushman
O. *bartschi plana* Cushman

Operculinella venosa (F. & M.)
Miogypsina irregularis S. orientalis Douvillé
M. *polymorpha* Rutten
M. *sp.*
Spiroclypeus margaritatus Schlumberger
S. *leupoldi* Van der Vlerk
Gypsina globulus Reuss
G. *inhoerens plana* Carter
Gypsina vesicularis discus Goes
Nummulites sp.
Amphistegina lessoni d'Orbigny
Carpenteria proteiformis Goes
C. *capitata* J. and C. ?
Planorbulinella larvata P. and J.
Sporadotrema cylindricum (Carter)
Orbitolites (*Marginopora*) *vertebralis* Gaimard and Quoy
O. (*Sorites*) *duplex* Carpenter
O. (?) *martini* Verbeek
Alveolina (s.s.) sp.
Alveolinella bontangensis Rutten
A. *quoyi* d'Orbigny

The full accounts of these rocks and the detailed descriptions of the large foraminifera contained in them will be given in the Science Reports of the Tohoku Imperial University, 2nd Ser. (Geology), Vol. XI, No. 3.